# Study on Evaluation Indicator System and Methods of PE Teaching

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**Abstract.** Teaching evaluation plays a key role in improving university teaching management, and how to evaluate university teaching is one of the difficulties and hot research fields for the researchers related. The paper takes university PE evaluation for example and presents a new model for evaluating university teaching based on improved BP neural network algorithm. First an evaluation indicator system of university PE teaching evaluation with three grades is designed; Second, aiming at the shortages of the existing BP neural network algorithm, wavelet and BP neural network algorithm are integrated and some improvements are advanced to speed up the convergence, simplify the algorithm structure and improve evaluating accuracy of the original BP model. Finally the model is realized with the data from three universities and the realization of the experimental results show that the model can improve algorithm efficiency and evaluation accuracy and can be used for university PE teaching evaluation practically.

**Keywords:** Teaching management, PE teaching evaluation, BP neural network algorithm, Wavelet.

## 1. Introduction

Colleges and universities shoulder the divine mission of training the successors with high quality and high esthetic sentiment. To strengthen the training of musicianship and quality of university students is the modernized, technological and humanized demand of education. As an important subject of art education, PE is considered to an important subject, is the contents of life-long education, is the education contents of the entire society, and is the education contents of schools, especially institutions of higher learning, a holy place for the emergence of talents. Hence, study on the education quality evaluation of university PE teaching has also become one of the research hotspots in the industry, the research contents of which include the study on evaluation system of university PE teaching and evaluation method. This paper will take university PE teaching as example to carry out the study on evaluation indicator system of university PE teaching and evaluation method [1].

## 2. Literature Review

As for the study on current literatures of university course education, this paper mainly summarizes from such three perspectives as evaluation contents, evaluation principles and evaluation methods. ① At present, as for the course evaluation contents, scholars at home and abroad have a variety of views. Huang Puquan and etc. consider that the contents of course evaluation are teachers, teaching conditions, teaching implementation process and teaching effects [1]. And Yang Jing's views are teaching syllabus, teaching materials, teachers, lab construction, teaching process and teaching effect evaluation [2]. Zhao HongGuang thinks that the evaluation contents shall include course planning, teaching reform, imparting knowledge and educating people, teachers, teaching materials construction, teaching status, teaching effects evaluation [3]. Zhang Hongwei and etc. consider that the contents of course evaluation include teachers, teaching conditions, teaching quality and teaching management. ② Currently, as to the course evaluation principles, scholars at home and abroad also

hold different views [4]. Professor Yu Jinghuai thinks that the principles to be obeyed for course evaluation of colleges and universities are to meet the education teaching law, combine scientificity with feasibility, combine qualitative indicators with quantitative indicators and combine basic indicators with characteristic indicators [5]. Zheng Xiaomei's view is directionality principle, objectivity principle, typicality principle, comparability principle, quantification principle and feasibility principle [6]. ③ As for evaluation methods, Analytic hierarchy process, Fuzzy comprehensive evaluation, Data Mining evaluation are three mainstream methods and in which BP neural network evaluation, as a typical data mining method, is most welcomed by the most researchers for its high evaluation accuracy and powerful data mining ability. But BP neural network algorithm is easy to be trapped into defects like local minimum, over-learning, strong operation specialization which limited practical uses in engineering evaluation [7-9].

In the specific evaluation process of university PE teaching, this paper, as for evaluation contents, mainly focuses on teaching management, course construction, teaching conditions, teaching process, teachers and teaching effects; as for evaluation principles, launching from such four aspects as experts' evaluation, internal evaluation, self-evaluation and social evaluation, obtaining evaluation data by adopting the above principles as for the data selection of specific evaluation indicators; as for evaluation method, genetic algorithm improved with BP neural network algorithm for universities to evaluate its PE teaching is presented to overcome the question of slow convergence speed of BP neural network.

## 3. Evaluation Indicator System Design

In order to improve the scientificity of university PE teaching evaluation, we shall embody the abstract evaluation objectives. Indicators are one of the stipulations of objectives; they are specific, measurable and operable objectives. Only the indicator system formed by several specific indicators of systemization and close connection can reflect the entire objective, reduce the possibility of evaluation discrepancy caused by the difference of evaluators' level, perspective and impression, decrease the subjectivity of evaluation, and increase objectivity. It is thus clear that the establishment of evaluation indicator system is the key to guarantee the unified criteria, justice and objectivity of evaluation. Therefore, this paper, while establishing university PE teaching evaluation indicator system, focuses on such principles for choosing indicators as conformity to teaching objectives, direct measurability and comparability of objectives and an evaluation indicator system is constructed with 6 first-class indicators, 12 second-class indicators, 25 third-class indicators according to practical situation as the observation point of evaluation, as shown in Table 1.

## 4. Evaluation Algorithm Design

### 4.1. Legendre Wavelets Neural Network Model Design.

Wavelets can provide multi-resolution proximity for function differentiation as well as localization of space and frequency. Therefore, wavelets neural network based on wavelets analysis theory is more adaptable to learn locally non-linear and rapidly changing functions. Legendre wavelets is Formula1, in which *m*, the order of Legendre polynomial and *t*, the time, are defined in the interval $[0,1)$ to satisfy Formula 2. In Formula 2, $L_m(t)$ is the Legendre polynomial, in which $L_0(t)=1$、 $L_1(t)=t$ and the others satisfy the Recursion Formula 3. It can be proved that for different values of $n$, Legendre wavelets remain orthonormal.

$$\psi_{nm}(t) = \psi(k, \hat{n}, m, t), \quad k = 2,3\ldots, \quad \hat{n} = 2n-1, \quad n = 1,2\ldots 2^{k-1} \tag{1}$$

$$L_{m+1}(t)=\frac{2m+1}{m+1}tL_m(t)-\frac{m}{m+1}L_{m-1}(t) \tag{2}$$

$$\psi_{nm}(t)=\begin{cases}[m+\frac{1}{2}]^{1/2}2k/2L_m(2^k t-\hat{n}), & \frac{\hat{n}-1}{2^k}\le t\le\frac{\hat{n}+1}{2^k}\\ 0 & others\end{cases} \tag{3}$$

Table 1. Evaluation indicator system of university PE teaching

| Target Hierarchy | First-class Indicator | Second-class Indicator | Third-class Indicator |
|---|---|---|---|
| University PE Teaching evaluation | Teaching management | Teaching organization | Setting of training objectives |
| | | | Teaching syllabus |
| | | Teaching implementation | Implementation of teaching contents |
| | | | Implementation of teaching management |
| | | Teaching monitoring | Teaching inspection |
| | | | Teaching evaluation |
| | | | Teaching supervision |
| | Course construction | Teaching contents | Selection of PE teaching materials |
| | | | Selection of PE tracks |
| | | | Arrangement of PE skills |
| | | Design of teaching documents | Design of teaching objectives |
| | | | Arrangement of teaching progress |
| | Teaching conditions | Teaching facilities | Construction of teaching venues |
| | | | PE teaching equipment |
| | Teaching process | Teaching methods | Interactive methods |
| | | | Teaching design |
| | | | Training method of PE skills |
| | | Teaching skill test | PE skill test |
| | Teacher factors | Teachers' teaching | Teaching ability |
| | | | Teaching attitude |
| | | Teachers construction | Teachers structure |
| | | | Teachers training |
| | Teaching effects | Mastery of PE skills | Students' Individual skills |
| | | | PE skills |
| | | PE quality | PE accomplishment |

From Formula 3, it can be known that a function $f(t)$ defined in the interval [0,1) can be approximated to be Formula 4, in which $C$ and $\psi(t)$ are Formula 5 and Formula 6 respectively [7].

$$f(t)\approx\sum_{n=1}^{2k-1M-1}\sum_{m=0}\rho_{nm}\psi_{nm}(t)=C^T\psi(t) \tag{4}$$

$$C=[c_{10},c_{11}\ldots,c_{1M-1},c_{20}\ldots c_{2M-1}\ldots c_{2^{k-1}0}\ldots c_{2^{k-1}M-1} \tag{5}$$

$$\psi(t)=[\psi_{10}(t),\psi_{11}(t),\ldots\psi_{1M-1}(t)\ldots\ldots\psi_{2^{k-1}M-1}(t) \tag{6}$$

By setting as the activation function of neural network, a Legendre wavelets neural network can be constructed through Formula 5 with a structure as follows[10].

(1)Input layer: to input digitalized original signals;

(2) Preprocessing layer: to divide the digitalized original signals inputted into $2^{k-1}$ groups, which will enter the corresponding Legendre wavelets basic function to get training;

(3) Hidden layer: divided into $2^{k-1}$ group nodes with each having $M$ Legendre wavelets basic functions to receive signals after preprocessing respectively. The weight for the hidden layer nodes are the proximity of Legendre wavelets coefficients;

(4) Output layer: to receive the output of the hidden layer. The output layer is linear nodes which are added to get the result [11].

### 4.2. Algorithm Structure Design.

In solving the Legendre wavelets, the values of $M$ and $k$ can be increased for better accuracy. The increase of value of $k$ is equivalent to subdivide the interval $[0,1)$ further, while the increase of value of $M$ is equivalent to increase the coefficient of the highest order of the polynomial on the correspondingly subdivided intervals. Considering the actual accuracy requirement and the printer and the calculated amount of the model, 3 is given to $M$ and 2 is given to $k$ in the actual solution. According to Formulas 4, 5 and 6, there are six Legendre wavelets basic functions, as is shown in Formula 7. Fig.1 offers its network structure [12].

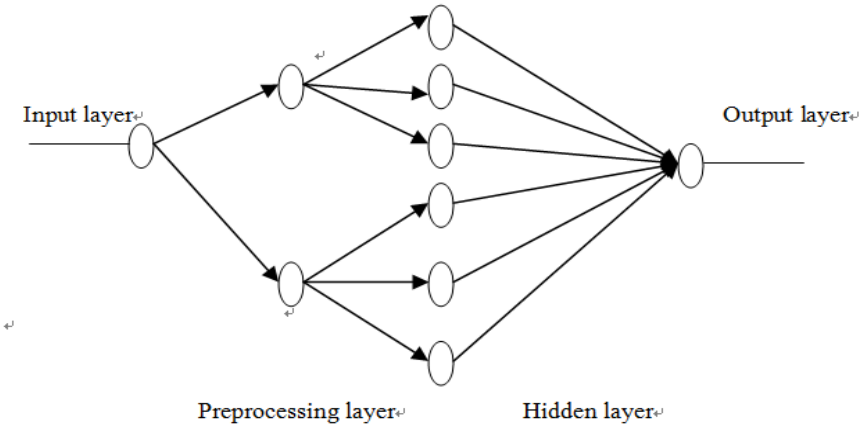


Fig. 1 Diagram of network structure of the improved algorithm

### 4.3. Algorithm Solution.

(1) Network training: The network training employs BPNN algorithm by assigning the values of Input layer from the transformation investigation value database as input value and that of weights of different indicator as output. In this algorithm, both weight value and threshold value are picked outrandomly in the range of -0.5~0.5, with adequate adjustment with regard to the real convergence.

(2) Initialization: to initialize the weight coefficient with a small random number.

(3) Circulation: to set an iteration number and load data to undergo network training. The weight coefficient required is acquired once the accuracy of designated color blocks is reached.

(4) Keep the value of weight coefficient of Legendre wavelets neural network and conclude the training.

## 5. Experimental Results and Analysis

Experimental data come from database of Shanghai University of Sports (SUS), and Shanghai Jiaotong University (SJU) and South China University of Technology (SCUT). Relevant data of 3000 learner of each university are selected as the basis for data training and experimental verification in the paper, totally 9000 learns' data for study data that come from practical investigation and visit of two specific PE students. In order to make the selected learners' data representatives, 1500 learners(500 learner from each university) with more than 3 years learning experience, 6000 learners with 2 years learning experience, 1500learners with less than 2 years learning experience.

Limited to paper space, the evaluation of intermediate results is omitted here, only providing parts evaluation results and final comprehensive evaluation results, see table 2 and table 3.

In order to prove the value of the algorithm presented in the paper, different algorithms which are popular used for different universities and researchers are realized with the same calculation platform in the paper. The indicators of the calculation platform can be listed as follows Intel i3 2120, 2GB DDR3, AMD Radeon HD 7450 and 3.3GHz CPU, and windows XP. The table 4 can shows that the evaluation accuracy and time consuming of the different algorithms. Form the table we can see clearly that the algorithm in the paper has greater value than that's of BP neural network [12] and fuzzy evaluation algorithms [1] in evaluation accuracy or time consuming. In realization practice, the

paper takes some obvious indicators as sample to calculate evaluation accuracy in order to make our comparison more believable.

Table 2. Parts of secondary evaluation results of different universities

| | Teaching management | Course construction | Teaching conditions | Teaching process | Teacher factors | Teaching effects | Final evaluation |
|---|---|---|---|---|---|---|---|
| SUS | 4.321 | 3.822 | 4.501 | 4.345 | 4.631 | 4.561 | 4.475 |
| SJU | 4.099 | 3.528 | 4.330 | 4.091 | 4.421 | 4.381 | 4.217 |
| SCUT | 3.993 | 3.408 | 4.185 | 3.872 | 4.199 | 4.175 | 3.988 |

Table 3. Realization results of different algorithms

| | Algorithm in the paper | Fuzzy Evaluation | Ordinary BP model |
|---|---|---|---|
| Evaluation Accuracy | 93.7% | 73.87% | 84.78% |
| Time Consuming (S) | 12 | 11 | 889 |

## 6. Conclusion

The evaluation of university course education is a complicated and multi-factor system problem, the study on which has certain difficulty. So, this paper, on the consideration of actual characteristics of university PE teaching, designs a set of evaluation indicator system of the course, and put forward a university course evaluation model based on improvement BP model according to the evaluation requirement of multi-factor complicated system. Test results indicate the engineering practicability of the evaluation model on university PE teaching evaluation. Model in this paper is also applicable to different evaluation indicator systems established for different courses. Hence, model in this paper has universal applicable value. In the next study, we shall pay attention to the combination of generality with individuality of evaluation indicator system as well as the robustness of evaluation methods.

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